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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/982,144	10/19/2001	Hideo Nakagawa	740819-673	7544

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EXAMINER

ANDUJAR, LEONARDO

ART UNIT	PAPER NUMBER
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2826

DATE MAILED: 01/21/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/982,144

Applicant(s)

NAKAGAWA ET AL.

Examiner

Leonardo Andújar

Art Unit

2826

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11/05/2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 is/are pending in the application.
- 4a) Of the above claim(s) 8-12 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7 and 13 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/05/2003 has been entered.

Election/Restrictions

2. Applicant's election without traverse of Group I (claims 1-7) in Paper No. 5 is acknowledged.

Priority

3. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant Ventkatesan et al. (US 6,326,301) in view of Admitted Prior Art (hereafter APA).

6. Regarding claim 1, Ventkatesan (e.g. fig. 9) shows most aspects of the instant invention including a semiconductor device comprising: a metal interconnects made from a multi layer film composed of a first metal film 14 deposited on a semiconductor substrate; a second metal film 34 which is a seed layer deposited on the first metal film; an interlayer insulating film 18 formed over the metal interconnects; a via hole formed in the interlayer insulating and for exposing the second metal film; and a plug 36 made from a third metal film selectively grown on the second metal film that is exposed at the bottom of the via hole. Also, the seed layer laminated on the first metal film. Ventkatesan does not explicitly depict an insulating film sandwiched between the first metal film and the substrate. Nonetheless, this limitation is implicitly taught by Ventkatesan since the metal film (14/12) is a multilevel interconnection (col. 5/lis. 46-51). As it is well known the art a multilevel interconnection includes one or more insulating films sandwiched between the metal films and the substrate (see for example applicant admitted prior art fig. 17A). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form an insulating film sandwiched between the first metal film and the substrate to isolate the first metal film from the substrate or from any electronic component formed in the substrate surface.

7. Regarding claim 2, Ventkatesan discloses that the third metal film is grown by plating (col. 11/lis. 43-47).

8. Regarding claim 3, Ventkatesan discloses that the second metal film and the third metal film are both made of copper (col. 11/lis. 43-47).

9. Regarding claim 4, Ventkatesan teaches that the second metal film and the third metal film are made from a metal including copper as a principal constituent (col. 11/lis. 43-47). The third layer is grown by plating and no adhesive is formed between the metal interconnects (e.g. fig. 9).

10. Regarding claim 5, Ventkatesan teaches that an air gap is formed between the metal interconnects in the insulating film (col.5/ lls. 56-62).

11. Regarding claim 6, Ventkatesan shows a first and second metal, which inherently have resistance values. Ventkatesan does not explicitly teach the resistant ratio of the interconnection layers. Nonetheless, it well known in the art those resistance ratios of the interconnection layers are subject to optimization. For example, US 6,136,707 teaches that the requirement for providing a low resistance electrical path is fulfilled by choosing the seed layer to be comprised of an adequately thick, low resistivity material (col. 1/lis. 33-36). In this case, the specific ratio claimed by applicant, i.e., "wherein said first metal film composing said metal interconnect has interconnect resistant substantially $1/5$ /or less of interconnect resistance of said second metal film composing said metal interconnects", absent any criticality, is only considered to be the "optimum" resistant ratio of the metal interconnect layers disclosed by the Prior Art that a person having ordinary skill in the art would have been able to determine using routine experimentation based, among other things, on the desired accuracy, manufacturing costs, low resistance electrical path, etc. (see In re Boesch, 205 USPQ 215 (CCPA 1980)), and since neither non-obvious nor unexpected results, i.e., results which are

different in kind and not in degree from the results of the prior art, will be obtained as long as the interconnection is used as already suggested by the Prior Art.

12. Regarding claim 7, Ventkatesan shows a first and second metal, which inherently have resistance values. Ventkatesan does not explicitly teach the resistance of the first metal layer is substantially equivalent to the resistance of the second layer. Nonetheless, it well known in the art that the resistance ratio of the interconnection layers is subject to optimization. For example, US 6,136,707 teaches that the requirement for providing a low resistance electrical path is fulfilled by choosing the seed layer to be comprised of an adequately thick, low resistivity material (col. 1/lis. 33-36). In this case, the specific resistance claimed by applicant, i.e., "wherein said first metal film composing said metal interconnect has interconnect resistant substantially equivalent to interconnect resistance of said second metal film composing said metal interconnects", absent any criticality, is only considered to be the "optimum" resistant ratio of the metal interconnect layers disclosed by the Prior Art that a person having ordinary skill in the art would have been able to determine using routine experimentation based, among other things, on the desired accuracy, manufacturing costs, low resistance electrical path, etc. (see *In re Boesch*, 205 USPQ 215 (CCPA 1980)), and since neither non-obvious nor unexpected results, i.e., results which are different in kind and not in degree from the results of the prior art, will be obtained as long as the interconnection is used as already suggested by the Prior Art.

13. Regarding claim 13, Ventkatesan teaches that an air gap is formed between the metal interconnects in the insulating film (col.5/ lis. 56-62). Although Ventkatesan does

not teach that the width of the air gap is substantially equal to the space between the metal interconnections as that claimed by Applicant, the width differences are considered obvious design choices and are not patentable unless unobvious or unexpected results are obtained from these changes. It appears that these changes produce no functional differences and therefore would have been obvious. Note *In re Leshin*, 125 USPQ 416. Moreover, it is conventional in the art to make the air gaps having a width equal or substantially equal to the space of between the metal interconnections as evidenced by APA's figure 20B.

Response to Arguments

14. Applicant's arguments with respect to claims 1-7 and 13 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

15. Papers related to this application may be submitted directly to Art Unit 2826 by facsimile transmission. Papers should be faxed to Art Unit 2826 via the Art Unit 2826 Fax Center located in Crystal Plaza 4, room 3C23. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2826 Fax Center number is **(703) 308-7722** or **-7724**. The Art Unit 2826 Fax Center is to be used only for papers related to Art Unit 2826 applications.

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Leonardo Andújar** at **(703) 308-0080** and between the hours of 9:00 AM to 7:30 PM (Eastern Standard Time) Monday through Thursday or by e-mail via Leonardo.Andujar@uspto.gov. If attempts to reach the examiner by

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telephone are unsuccessful, the examiner's supervisor, Nathan Flynn, can be reached on (703) 308-6601.

17. Any inquiry of a general nature or relating to the status of this application should be directed to the **Group 2800 Receptionist** at **(703) 305-3900**.

18. The following list is the Examiner's field of search for the present Office Action:

Field of Search	Date
U.S. Class / Subclass (es): 257/678, 773, 774, 775; 438/618, 622, 625	01/04
Other Documentation:	
Electronic Database(s): East (USPAT, US PGPUB, JPO, EPO, Derwent, IBM TDB)	01/04

Leonardo Andújar

Patent Examiner Art Unit 2826

LA

1/07/04

